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U.S. Department of Energy
Idaho Operations Office

Operable Unit 3-13, Group 3, Other Surface Soils Remediation Sets 1–3 (Phase I) Field Sampling Plan

INEEL
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Idaho National Engineering and Environmental Laboratory

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ABSTRACT

This Field Sampling Plan describes the Operable Unit 3-13, Group 3, Other Surface Soils, Remediation Sets 1–3 (Phase I) remediation field sampling activities to be performed at the Idaho Nuclear Technology and Engineering Center located within the Idaho National Engineering and Environmental Laboratory. Sampling activities described in this plan support confirmation that the remedial action objectives and remediation goals presented in the *Final Record of Decision for Idaho Nuclear Technology and Engineering Center, Operable Unit 3-13* have been met.

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ACRONYMS

AA	alternative action
AL	action level
ALS	alpha spectrometry
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	contaminant of concern
COPC	contaminant of potential concern
CPP	Chemical Processing Plant
CV	coefficient of variance
DAR	document action request
DOE	Department of Energy
DOT	Department of Transportation
DQA	data quality assessment
DQO	data quality objective
DS	decision statement
EPA	Environmental Protection Agency
ER	environmental restoration
FFA/CO	Federal Facility Agreement and Consent Order
FSP	field sampling plan
FTL	field team leader
GFP	gas flow proportional
GMS	gamma spectrometry
HASP	health and safety plan
HPGe	high-purity germanium
ICDF	INEEL CERCLA Disposal Facility
ICP	Idaho Completion Project
ID	identification

IDEQ	Idaho Department of Environmental Quality
IEDMS	Integrated Environmental Data Management System
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
LSC	liquid scintillation counting
MCL	maximum contaminant level
MDA	minimum detectable activities
MDL	method detection limits
MQO	measurement quality objectives
NE-ID	Department of Energy Idaho Operations Office
OU	operable unit
PPE	personal protective equipment
PSQ	principal study question
QA	quality assurance
QAPjP	Quality Assurance Project Plan
QC	quality control
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RCT	radiological control technician
RD/RA	remedial design/remedial action
RG	remediation goal
ROD	Record of Decision
SAM	sample and analysis management
SAP	sampling and analysis plan
SOW	Statement of Work
SRPA	Snake River Plain Aquifer
WAG	waste area group

Operable Unit 3-13, Group 3, Other Surface Soils Remediation Sets 1–3 (Phase I) Field Sampling Plan

1. INTRODUCTION

In accordance with the *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory* (FFA/CO) (DOE-ID 1991), the U.S. Department of Energy (DOE) submits the following remedial action Field Sampling Plan (FSP) for the Idaho National Engineering and Environmental Laboratory (INEEL), Operable Unit (OU) 3-13, Group 3, Other Surface Soils Remediation Sets 1–3 (Phase I). This FSP provides guidance for the collection of samples needed to support the remediation of the Other Surface Soils Remediation Sets 1–3.

This FSP is implemented with the latest revision of the *Quality Assurance Project Plan for Waste Area Groups 1, 2, 3, 4, 5, 6, 7, 10 and Inactive Sites* (QAPjP) (DOE-ID 2002), which provides guidance for sampling, quality assurance (QA), quality control (QC), analytical procedures, and data management. Together, the QAPjP and this FSP constitute the remedial action Sampling and Analysis Plan (SAP). The QAPjP describes the objectives and QA/QC protocols that will achieve the specified data quality objectives (DQOs). Use of this FSP will help ensure that data are scientifically valid, defensible, and of known and acceptable quality, while use of the QAPjP will ensure that the data generated are suitable for their intended purposes.

The QAPjP and this FSP have been prepared pursuant to the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988), the FFA/CO, and company policies and procedures.

1.1 Field Sampling Plan Objectives

The overall objective of this FSP is to guide the collection and analyses of sample data during implementation of the selected remedial actions for OU 3-13, Group 3, Other Surface Soils, Remediation Sets 1–3 presented in the OU 3-13 Record of Decision (ROD) (DOE-ID 1999). The ROD-selected remedy for this remedial action includes excavating the soils, disposing of them appropriately, performing confirmation sampling, and backfilling the excavation with clean fill.

Based on the DQOs developed in Section 3.1 of this plan, this FSP will support post-remediation sampling to confirm that the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) ROD-defined, remediation goals (RGs) have been met to ensure protection of human health and the environment. Table 1-1 identifies the risk-based remediation goals for OU 3-13 soils. The principal threat posed by the Group 3 sites is external exposure to contaminated soils. The selected remedy for the Group 3 sites will eliminate this threat by removing the contaminated soils. The remedy will also eliminate the potential threat to the underlying Snake River Plain Aquifer (SRPA) from possible leaching of residual contamination at the Group 3 sites. Table 1-2 identifies the SRPA remediation goals.

Table 1-1. Risk-based remediation goals for Operable Unit 3-13 soils.

Contaminant of Concern (COC)	Soil Risk-Based Remediation Goal for Single COCs (pCi/g or mg/kg)
Radionuclides	
Am-241	290
Cs-137	23
Eu-152	270
Eu-154	5,200
Pu-238	670
Pu-239/240	250
Pu-241	56,000
Sr-90	223
Nonradionuclides	
Mercury (human health)	23

Table 1-2. Remediation goals for the Snake River Plain Aquifer.

Contaminant of Concern	SRPA Remediation Goals (Maximum Contaminant Levels) for Single COCs[a]	Decay Type
Beta-gamma emitting radionuclides	Total of beta-gamma emitting radionuclides shall not exceed 4 mrem/yr effective dose equivalent	Beta-gamma
Sr-90 and daughters	8 pCi/L	Beta
Tritium	20,000 pCi/L	Beta
I-129	1 pCi/L[b]	Beta-gamma
Alpha-emitting radionuclides	15 pCi/L total alpha-emitting radionuclides	Alpha
Uranium and daughters	15 pCi/L	Alpha
Np-237 and daughters	15 pCi/L	Alpha
Plutonium and daughters	15 pCi/L	Alpha
Am-241 and daughters	15 pCi/L	Alpha
Nonradionuclides		
Chromium	100 μg/L	Not applicable
Mercury	2 μg/L	Not applicable

a. If multiple contaminants are present, use a sum of the fractions to determine the combined COC's remediation goals.
b. Derived concentration if only beta-gamma radionuclide present.

2. BACKGROUND

The INEEL encompasses 2,305 km^2 (890 mi^2) and is located approximately 55 km (34 mi) west of Idaho Falls in southeastern Idaho (Figure 2-1). The United States Atomic Energy Commission, now the DOE, established the Nuclear Reactor Testing Station, now the INEEL, in 1949 as a site for building and testing nuclear facilities. At present, the INEEL supports the engineering and operations efforts of DOE and other federal agencies in areas of nuclear safety research, reactor development, reactor operations and training, nuclear defense materials production, waste management and technology development, energy technology, and conservation programs.

2.1 INTEC—Waste Area Group 3

The Idaho Nuclear Technology and Engineering Center (INTEC), formerly known as the Idaho Chemical Processing Plant, is located in the south-central portion of the INEEL. From 1952 to 1992, operations at INTEC primarily involved reprocessing spent nuclear fuel from defense projects, which entailed extracting reusable uranium from the spent fuels. Liquid waste generated from the reprocessing activities, which ceased in 1992, is stored in an underground tank farm at INTEC. Both soil and groundwater contamination has resulted from these previous operations. Under the FFA/CO, the U.S. Environmental Protection Agency (EPA), Idaho Department of Environmental Quality (IDEQ), and U.S. Department of Energy Idaho Operations Office (NE-ID)[a] (collectively referred to hereafter as the Agencies) are directing cleanup activities to reduce human health and environmental risk to acceptable levels. The INTEC is designated as Waste Area Group (WAG) 3, in accordance with the FFA/CO.

2.2 Operable Unit 3-13, Group 3, Other Surface Soils

Waste Area Group 3 was subdivided into 13 OUs that were investigated for contaminant releases to the environment. Fifty-five contaminant release sites were identified within OU 3-13 requiring remedial action to mitigate risks to human health and the environment under a future residential use scenario. These sites were then grouped into seven groups that share common characteristics and contaminant sources. Group 3, Other Surface Soils, is further divided into Remediation Sets 1 through 6. Ten of the 55 release sites are included in Sets 1, 2, and 3. The characterization and remediation of Sets 1, 2, and 3 are to be completed as Phase 1 of the OU 3-13, Group 3, Other Surface Soils remediation project.

Remediation Sets 1, 2, and 3 include the following release sites, which are indicated in Figure 2-2:

- Set 1: Chemical Processing Plant (CPP)-97, CPP-92, CPP-98, and CPP-99
- Set 2: CPP-37B and CPP-37C
- Set 3: CPP-03, CPP-37A, CPP-67, and CPP-34A/B.

Contaminants within these remediation sets include radionuclides, inorganics, and possible Resource Conservation and Recovery Act (RCRA)-listed wastes. The OU 3-13 ROD identifies contaminants of concern (COCs) for Group 3 to include americium (Am)-241, cesium (Cs)-137, europium (Eu)-152, Eu-154, plutonium (Pu)-238, -239, -240, and -241, strontium (Sr)-90, and mercury (Hg) (DOE-ID 1999).

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a. NE-ID signifies that the U.S. Department of Energy Idaho Operations Office reports to the DOE Office of Nuclear Energy, Science, and Technology (NE).

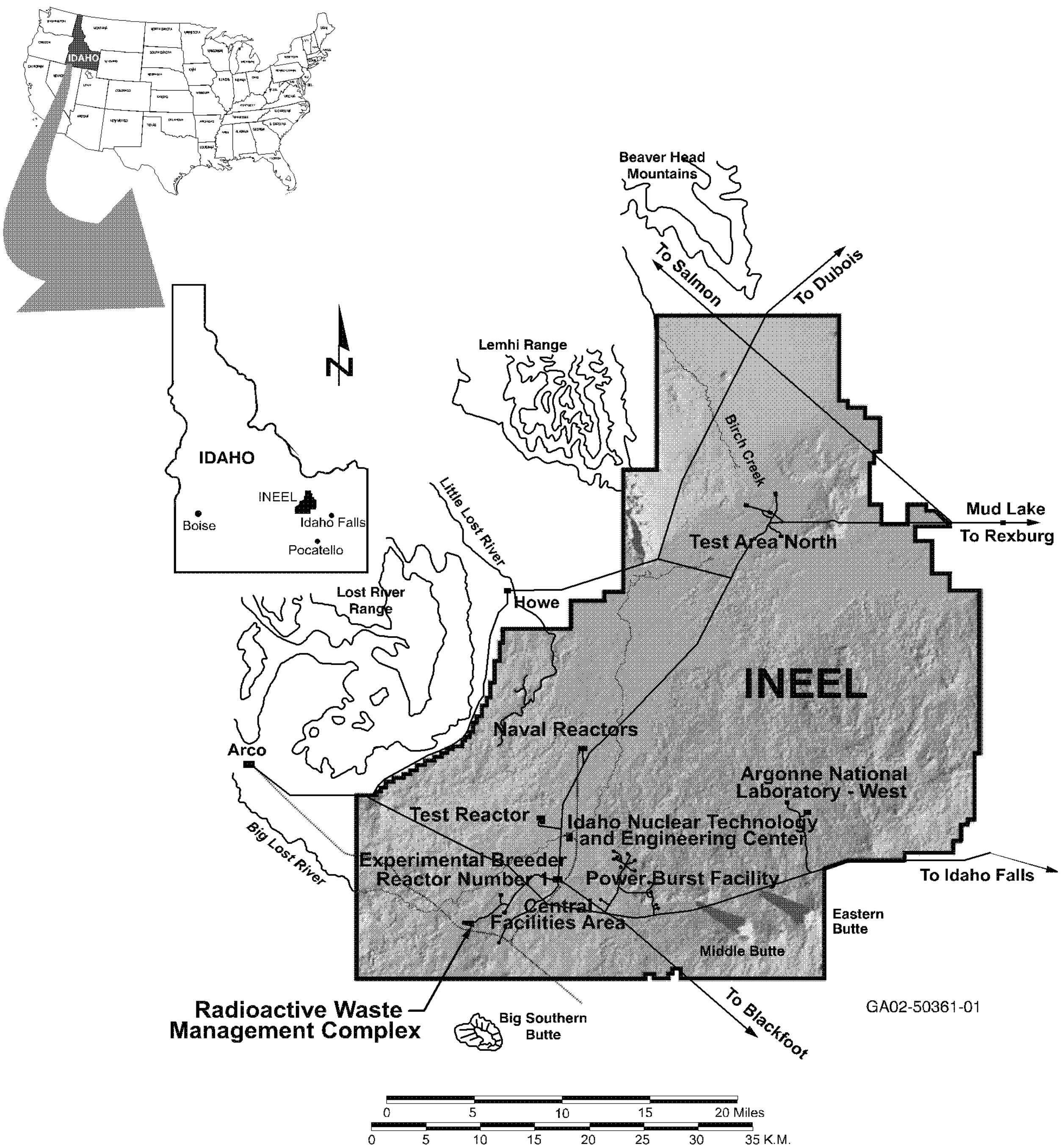


Figure 2-1. Location of the Idaho National Engineering and Environmental Laboratory.

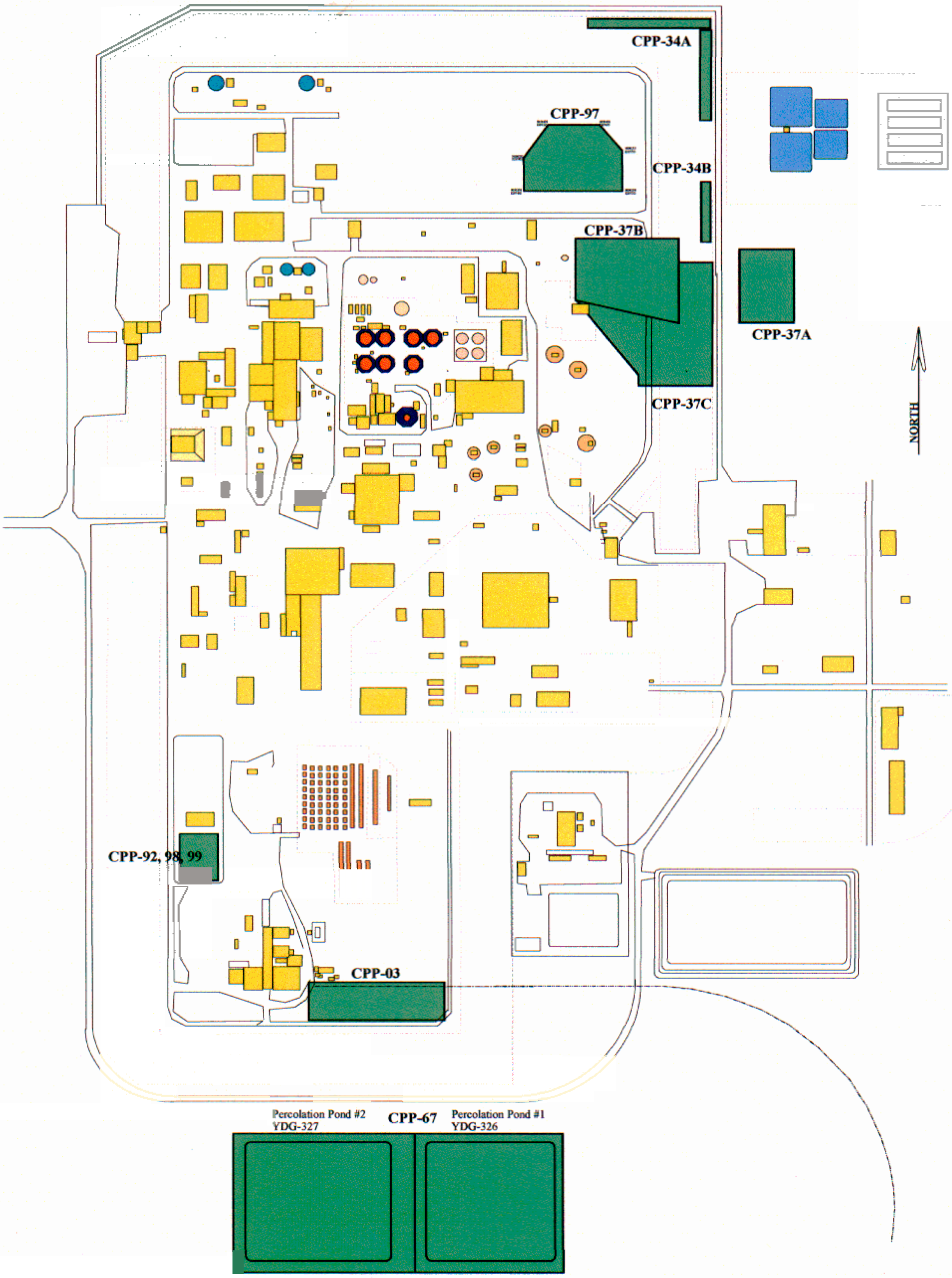


Figure 2-2. Operable Unit 3-13, Group 3, Other Surface Soils, Remediation Sets 1–3 (Phase I) sites.

3. SAMPLING AND DATA QUALITY OBJECTIVES

The following sections outline the objectives of the sampling activities described in this FSP and the criteria associated with data collected. Data quality objectives and measurement performance criteria are developed and discussed in detail.

3.1 Data Quality Objectives

The DQO process, which is used to specify the objectives for the data collected, was designed as a specific planning tool to establish criteria for defensible decision-making and to facilitate the design of the data acquisition efforts. The DQO process is described in the EPA document *Data Quality Objectives for Hazardous Waste Site Investigations* (EPA 2000). The DQO process includes seven steps, each of which has specific outputs. Each of the following subsections corresponds to a section in the DQO process and provides the output for each step.

3.1.1 Problem Statement

The first step in the DQO process is to use relevant information to clearly and concisely state the problem to be resolved. Its intent is to define the problem so that the focus of the sampling and analysis will be unambiguous.

The ROD declaration states, in part, that conventional excavation methods will be used to remove contaminated soils and debris above the 1×10^{-4} risk level (based on an assumed future residential use in the year 2095 and beyond) and replace the contaminated soil with clean soil, so that from the surface to a depth of 3 m (10 ft), the land can be released for future residential use (DOE-ID 1999). However, the ROD also states that contamination ***below*** 3 m (10 ft) may be excavated at the discretion of DOE if this approach is determined to be more cost effective than maintaining institutional controls necessary to prevent future drilling through deep contamination zones and transportation of contaminants to the underlying aquifer.

An excavation decision process, specified in the Remedial Design/Remedial Action (RD/RA) Work Plan (DOE-ID 2004a), has been developed to evaluate whether soil contamination has been removed to a level that is protective of human health and the environment. This decision process specifies that the soil RGs are the action levels (ALs) up to the design excavation depth or 10 ft below ground surface. If the excavation reaches 10 ft below grade and soil contaminant concentrations are still above the RGs, additional samples will be collected and analyzed for the SRPA COCs and Tc-99. Analysis for Tc-99 stems from recent detections of Tc-99 in an aquifer well located within the INTEC fence that reported levels above the maximum contaminant level (MCL). The OU 3-13 ROD never predicted Tc-99 to exceed the MCL; thus, it was never listed as a COC. Analysis results for Tc-99 will be used for future groundwater modeling. The groundwater model will then be run, using the SRPA COCs and Tc-99 analytical results to determine the risk posed to the aquifer by the residual soil contamination, until the updated Group 4 aquifer model is available. The groundwater model will be conservatively parameterized to estimate aquifer risk and be consistent with data gathered during the Group 4 remedial work.

The two problem statements for the OU 3-13, Group 3, Other Surface Soils, Remediation Sets 1–3 (Phase I) soil sites are, then, as follows: (1) sampling is required to confirm that residual contaminant concentrations at or below the design excavation depth do not exceed CERCLA RGs for soil following completion of the remediation activities for each site and (2) additional sampling for the SRPA COCs is required if the excavation reaches 10 ft below grade and soil COC concentrations are still above the RGs.

These problem statements only apply to the sites where soil excavation is the remedial action and, therefore, excludes Sites CPP-92, -98, and -99. The waste at these three sites is boxed and stored at a staging and storage area designated as Site CPP-1789. The problem statements also exclude Sites CPP-37A, -37B, and -37C. Existing data for these sites show no COCs greater than the soil RGs at any depth; therefore, no remediation is planned for these sites at this time.

Additionally, remedial action objective (RAO) confirmation sampling will only apply to those soil COCs (Table 1-1) that were found to exceed RGs during pre-remediation site characterization sampling and analysis. Table 3-1 shows those COCs exceeding the RGs based on previous sampling efforts. Characterization sampling outlined in the Characterization Plan (DOE-ID 2004b) may also identify additional COCs that apply to RAO confirmation sampling.

Table 3-1. Contaminants of concern exceeding remedial goals identified from previous sampling efforts.

Site	Description	COCs
CPP-97	Tank farm soil stockpile—two tarp-covered stockpiles and contaminated surface soil	Cs-137, Sr-90
CPP-03	Temporary storage area southeast of CPP-603	Cs-137
CPP-67	Percolation Ponds 1 and 2	Cs-137, mercury, I-129
CPP34A/B	Soil storage areas (disposal trenches) in northeast corner of INTEC	Cs-137, Sr-90

3.1.2 Principal Study Questions and Decision Statements

This step in the DQO process identifies the decisions and actions that will be taken based on the data collected for a given site. The study questions and their corresponding alternative actions (AAs) will then be joined to form decision statements (DSs). The objective of this characterization activity is to answer the principal study questions (PSQs).

The objective of the soil sampling specified in this FSP is to answer the following PSQs and to confirm compliance with CERCLA RGs:

- PSQ 1: Do residual concentrations of contaminants in the soils within the excavation area at the design excavation depth for which CERCLA RGs have been established meet the associated CERCLA RGs?

  The AAs to be taken depending on the resolution to PSQ 1 are as follows:

  - AA 1.1: If the residual concentrations of contaminants for which CERCLA RGs have been established meet the associated CERCLA RGs, then no further action is required for the soils.

  - AA 1.2: If the residual concentrations of contaminants for which CERCLA RGs have been established do <u>not</u> meet the associated CERCLA RGs, then the excavation will be evaluated per the RD/RA Work Plan.

- PSQ 2: Do residual concentrations of contaminants in the soils within the excavation area applied to the soil mass (from the excavation depth to basalt), pose an unacceptable threat to groundwater based on the associated CERCLA RAOs for groundwater?

The AAs to be taken depending on the resolution to PSQ 2 are as follows:

- AA 2:1: If the residual concentrations of contaminants in the soils within the excavation area applied to the soil mass (from the excavation depth to basalt) do not pose an unacceptable threat to groundwater based on the CERCLA RAOs, then no further action is required for the soils.

- AA 2:2: If the residual concentrations of contaminants in the soils within the excavation area applied to the soil mass (from the excavation depth to basalt) pose an unacceptable threat to groundwater based on the CERCLA RAOs, then implementing institutional controls versus further remediation will be evaluated.

Combining PSQ 1 and the associated AAs results in the following DS:

- DS 1: Determine if the residual concentrations of soil COCs (Table 1-1) within the excavation area at the design excavation depth meet the associated CERCLA RGs, or if additional excavation or other remediation activities are required.

Combining PSQ 2 and the associated AAs results in the following DS:

- DS 2: Determine if the residual concentrations of contaminants in the soil within the excavation area applied to the soil mass (from the excavation depth to basalt) pose an unacceptable threat to groundwater, based on CERCLA RAOs.

3.1.3 Decision Inputs

The purpose of this step is to identify informational inputs that will be required to resolve the DSs and to determine which inputs require measurements.

The information required to resolve DS 1 is the identification and quantification of the soil COCs (Table 1-1) present in the soils remaining within the excavation area at the design excavation depth. The ALs to resolve DS 1 are the Other Surface Soils RGs defined in the OU 3-13 ROD (DOE-ID 1999).

The information required to resolve DS 2 is the identification and quantification of the SRPA COCs (Table 1-2) present in the soils remaining within the excavation area at the design excavation depth for which there is an associated groundwater RG and the output from the GWSCREEN model run. The ALs to resolve DS 2 are the groundwater RGs defined in the OU 3-13 ROD.

3.1.3.1 DS 2 Inputs. The GWSCREEN model (Rood 1999) or other agreed upon model will be used to evaluate aquifer risk prior to excavation. By conducting the modeling prior to excavation, a reasonable estimate of how many curies need to be removed prior to excavation can be determined. The GWSCREEN conceptual model assumes contaminants are mixed homogeneously with soil in the source zone and leached to the top of the unsaturated zone. The leaching rate is a function of the infiltration rate and the sorptive characteristics of the source zone soil. Transport through the vadose zone is accomplished by plug flow and the transport velocity will be a function of the infiltration rate, vadose zone sorptive characteristics, vadose zone unsaturated characteristics, and vadose zone thickness. Flow through the fractured basalt will be considered instantaneous and the GWSCREEN model will only consider flow through the interbeds. The GWSCREEN conceptual model is illustrated in Figure 3-1.

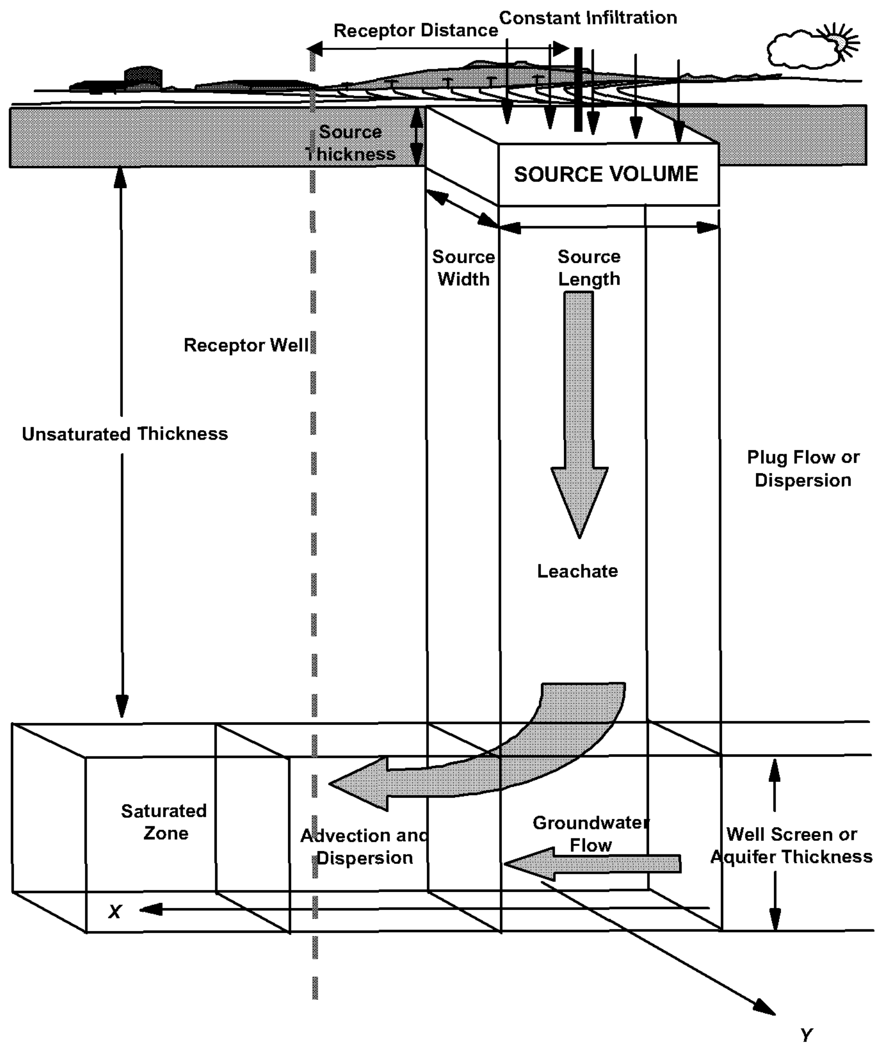


Figure 3-1. Conceptual model for GWSCREEN groundwater transport.

This modeling approach will use the linear sorption isotherm approach for simulating chemical interactions of the contaminant with the subsurface media. This approach assumes the sorption processes are linear and reversible and combines the processes into a single distribution coefficient (K_d) parameter. The K_d parameter partitions the contaminant between the aqueous and solid phases (i.e., $Cs=K_dC$ where: C_S=mass sorbed onto soil, K_d=distribution coefficient, and C=aqueous concentration).

The model will be conservatively parameterized to estimate aquifer risk and answer PSQ 2. These data include source zone size, source zone contaminant concentration, source zone sorptive characteristics, interbed thickness, interbed unsaturated characteristics, interbed sorptive characteristics, infiltration rate, and aquifer properties. Conservative model parameters will be estimated from Group 3 remedial work, Group 4 remedial work (DOE-ID 2003a), a Track 2 guidance document (DOE-ID 1994), a performance assessment document for the INEEL CERCLA Disposal Facility (ICDF) (DOE-ID 2003b), and a Group 5 Monitoring Report/Decision Summary report (DOE-ID 2004c). The source of GWSCREEN model parameters are as follows:

- The individual site sampling and excavation work performed during the Group 3 remedial work will provide the alluvium contaminated soil concentration, source area, and source depth.

- Alluvium source zone bulk density and unsaturated characteristics will be taken from Group 4 remedial work (DOE-ID 2003a). The OU 3-13 Group 4 remedial work collected a total of 37 surficial alluvium and interbed samples during Phase I drilling. Laboratory testing was performed to develop soil moisture characteristic curves and to determine material particle size distribution, porosity, effective porosity, bulk density, and initial moisture content.

- Total interbed thickness, unsaturated characteristics, and bulk density will be individually estimated for each soil site using the Group 4 remedial work data.

- Alluvium and interbed distribution coefficients will be taken from the waste/interbed K_d values used in the ICDF performance assessment (DOE-ID 2003b).

- The aquifer hydraulic parameters, except dispersivity, will be taken from the Group 5 aquifer model update (DOE-ID 2004c).

- Well screen thickness and aquifer dispersivity will be Track 2 values (DOE-ID 1994).

- Reasonable bounding estimates for infiltration will be used to assess the impact to groundwater from the more mobile and less mobile COCs.

Alternatively, the updated INTEC groundwater model will be used to determine risk posed to the aquifer by residual soil contamination if it is available. The INTEC groundwater model will be updated to be consistent with the data gathered during Group 4 remedial actions (DOE-ID 2003a) and will be used to support decisions to be presented in the Fiscal Year 2008 Group 4 monitoring report/decision summary document. The updated INTEC groundwater model will be run with unit residual sources at each of the contaminated soil sites. The residual aquifer risk will be evaluated by multiplying the unit source risk by the actual remaining source after excavation. This approach will allow rapid assessment of aquifer risk without repeated simulations that use a complex and unwieldy model. This approach is technically valid, if the hydraulics do not change with different excavation scenarios.

3.1.4 Study Boundaries

The primary objectives of this step are to identify the population of interest, define the spatial and temporal boundaries that apply to each DS, define the scale of decision-making, and identify practical constraints that must be considered in the sampling design. Implementing this step helps ensure that the sampling design will result in the collection of data that accurately reflect the true condition of the site under investigation.

The spatial boundaries of concern for this sampling effort are confined to the soil areas within the Group 3, Other Surface Soils, excavation boundaries. The excavation boundaries are assumed to be adequately defined for all sites.

Temporal constraints might exist for the sampling efforts described in this plan, if the initial sampling conducted after excavation to the design depth indicates that RGs have not been met. Subsequent excavation, sampling, and analysis would be required, as described in the decision process in the RD/RA Work Plan (Section 5.2), resulting in the excavation being left open during sample analyses and data evaluation by management. Therefore, samples should be collected as soon as possible after the excavation activities are completed, so the excavation is not open longer than necessary.

Results obtained from this sampling effort will be considered as adequate to confirm compliance with the OU 3-13 ROD requirements. There are no practical constraints expected to be encountered that would interfere with the collection of adequate soil volumes for analyses. Any limitations on data quality and/or usability resulting from sample collection constraints will be discussed in the data quality assessment report.

3.1.5 Decision Rules

The objective of this step is to define parameters of interest that characterize the population, specify the AL, and integrate previous DQO outputs into a single statement that defines the conditions that would cause the decision-maker to choose among AAs. The decision rule typically takes the form of an "***If…then***" statement describing the action to take if one or more conditions are met.

The decision rule is specified in relation to a statistical parameter that characterizes the population of interest. The parameter of interest for the Other Surface Soil samples will be the true mean concentration. The decision rule will involve a hypothesis test, described in Section 3.1.6. The hypothesis test will be performed assuming the data follow a normal distribution or can be transformed to follow a normal distribution using guidance from EPA (1989). The data will be tested for normality using the Shapiro-Wilk test and transformed if necessary. This procedure, however, is robust to departures from normality (Conover 1980). If a log transformation is made, then the transformed sample mean will be compared to the log transformed RG.

The decision rule is based on the requirement that residual contaminant concentrations in the excavated area meet the ROD-specified CERCLA RGs with respect to the COCs for the site.

The decision rules are as follows:

- ***If*** the true mean concentration of any COC for which a CERCLA RG has been established that is detected in total constituent analyses of soil samples collected from the excavated area following soil excavation meets the associated CERCLA RG at the design excavation depth, ***then*** no subsequent remediation activities will be required.

- ***If*** the true mean concentration of any COC for which a CERCLA RG has been established that is detected in total constituent analyses of soil samples collected from the excavated area following soil excavation does <u>not</u> meet the associated CERCLA RG at the design excavation depth, ***then*** subsequent remediation activities will be evaluated as described in the project RD/RA Work Plan.

3.1.6 Decision Error Limits

Since analytical data can only estimate the true condition of the site under investigation, decisions based on measurement data could potentially be in error. For this reason, the primary objective of this step is to determine if the DS developed for the Group 3, Other Surface Soils, sites requires a statistically based sample design. Determining the decision error limits specifies the decision-maker's tolerable limits on decision errors, which are used to establish performance goals for the data collection design.

Because decisions are based on measurement data, which provide only an estimate of the true state of the media being characterized, decisions are based on data that could be in error. Therefore, tolerable limits on the probability of making a decision error must be defined. The probability of decision errors can be controlled by using the data to select between one condition of the environment (i.e., the soil following excavation of the Other Surface Soils sites) and the alternative condition. One condition is assumed to be the baseline condition and is referred to as the *null hypothesis* (Ho). The alternative condition is the *alternative hypothesis* (H»). The null hypothesis is presumed to be true in the absence of strong evidence to the contrary, which allows decision-makers to guard against making the decision error with the most undesirable consequences. The null hypothesis is the assumption that the true mean concentration exceeds the RG. The alternative hypothesis is the assumption that the true mean concentration does not exceed the RG.

A decision error occurs when the decision-maker rejects the null hypothesis when it is true, or fails to reject the null hypothesis when it is false. These two types of decision errors are classified as *false positive* and *false negative* decision errors, respectively. False positive and false negative errors are defined in accordance with the definition of the null and alternative hypothesis. For example, a decision-maker presumes a certain waste is hazardous (i.e., the null hypothesis is "the waste is hazardous"). If the data cause the decision-maker to conclude that the waste is not hazardous when it truly is hazardous, then the decision-maker would make a false positive decision error. Statisticians refer to this error as a Type I error. The measure of the size of this error is called alpha (α), which is the level of significance or the size of the critical region. If, however, the data cause the decision-maker to conclude that the waste is hazardous when, in fact, it is not, then the decision-maker would make a false negative decision error. Statisticians refer to this error as a Type II error. The measure of the size of this error is called beta (β) and is also known as the complement of the power of a hypothesis test.

The possibility of decision error cannot be eliminated but it can be minimized, which is accomplished by controlling the total study error. Methods for controlling total study error include collecting a large number of samples (to control sampling design error), analyzing individual samples several times, or using more precise analytical methods (to control measurement error). The chosen method for reducing decision errors depends on where the greatest component of total study error exists in the data set and the ease in reducing the error contributed by those data components. The amount of effort expended on controlling decision error is directly proportional to the consequences of making an error.

The decision error that has the more severe consequences as the true concentrations of the parameters of interest approach the AL must be specified, as it is the basis for establishing the null hypothesis. This decision error is used because as the parameters approach the AL, the data are much more likely to lead to an incorrect decision than when the parameters are far above or below the AL. For regulatory compliance, human health, or environmental risk issues, the decision error that has the most adverse consequences will be favored as the null hypothesis. In statistical hypothesis testing, the data must conclusively demonstrate that the null hypothesis is false. Therefore, setting the null hypothesis to the condition that exists when the more adverse decision error occurs guards against making that decision error by placing the burden of proof on demonstrating that the most adverse consequences will not be likely to occur.

For DS 1, the concentrations of COCs will be assumed to exceed the CERCLA RGs unless proven otherwise (i.e., by collecting and analyzing samples following soil excavation). Thus, the alternative hypothesis is the assumption that the concentrations of COCs do not exceed the CERCLA RGs.

A range of possible parameter values must be specified where the consequences of decision errors are relatively minor. This range of values is referred to as the "gray region," which is bounded on one side by the AL and on the other side by the parameter value where making a false negative decision error begins to be significant (U). It is necessary to specify the gray region because the variability in the sample population and unavoidable imprecision in the measurement system combine to produce variability in the data such that a decision may be "too close to call" when the true parameter value is very close to the AL. In statistics, this interval is called the "minimum detectable difference" and is expressed as delta (Δ). The width of this gray region is critical in calculating the number of samples needed to satisfy the DQOs. A narrow gray region indicates a desire to detect conclusively the condition when the true parameter value is close to the AL. For the Other Surface Soils total constituent analysis, the gray region will be bounded on one side by the constituent-specific AL (i.e., RG) and on the other side by a value that is 70% of the constituent-specific AL.

The final activity required in specifying the tolerable limits on decision error is to assign values to the gray region that reflect the probability of decision errors occurring. These probability values are the decision-maker's tolerable limits for making an incorrect decision. These values are determined by selecting a possible true value for the parameter of interest, then choosing a probability limit based on an evaluation of the seriousness of the potential consequences of making a decision error if the true parameter value is located at that point.

The sample collection design for the Other Surface Soils sampling activities is discussed in the following section. An acceptable false positive decision error value of 0.05 (when the true mean concentration is equal to the AL) and an acceptable false negative decision error value of 0.20 (when the true mean concentration is equal to U) have been selected for this sampling design.

3.1.7 Design Optimization

The objective of this step is to identify the best sampling and analysis design that satisfies the previous DQO Steps 1 through 6. The activities required to optimize the design include

- Review the outputs of the first six steps and existing environmental data
- Develop general data collection design alternatives
- Formulate a mathematical expression needed to solve the design problem for each data collection design alternative
- Select the optimal number of samples to satisfy the DQOs for each data collection design alternative
- Select the most resource-effective data collection design that satisfies all the DQOs.

The outputs of the first six steps have been discussed previously. There are existing environmental data relevant to the Other Surface Soils remediation sites.

3.1.7.1 Sites CPP-97, CPP-03, CPP-67, and CPP-34A/B. A systematic random sampling approach will be used to determine sampling locations. (Additional bias samples may be collected if radiological screening identifies high areas of contamination or if there is visible soil staining.) With the systematic random sampling approach, a grid is used to divide the sampling area into potential sampling locations and a starting point is randomly selected. Samples are then collected at even intervals from the start point. Since samples are collected at regular intervals, systematic sampling is appropriate when the goal is to obtain an overall characterization of a site. For the Group 3, Other Surface Soils, remediation sites, the characterization goal is to determine if contamination is present and whether it exceeds established cleanup levels.

Although a systematic sample will be taken, a simple random sample design will be assumed for calculating the necessary sample size. Assuming any contamination is located randomly and not along a gradient, this approach produces unbiased estimates of the variance (EPA 1989) and equivalent sample size determination. When using a simple or composite random sampling approach, there are commonly accepted mathematical expressions to solve design problems for these data collection design alternatives (EPA 1989). The formula for determining the number of samples to be collected is selected based on the hypothesis test and data collection design. In this case, the hypothesis test will be of the null hypothesis that the concentration exceeds the AL versus the alternative hypothesis that the concentration is below the AL. The formula provided adjusts for using the standard normal Z instead of iteratively using the t distribution to determine sample size. Using this hypothesis test, the formula shown in Equation (3-1) is used for computing the number of samples required to be collected for a simple random sampling approach:

$$n = \frac{\sigma^2 \left(Z_{1-\beta} + Z_{1-\alpha}\right)^2}{\Delta^2} + (.5)Z_{1-\alpha}{}^2 \tag{3-1}$$

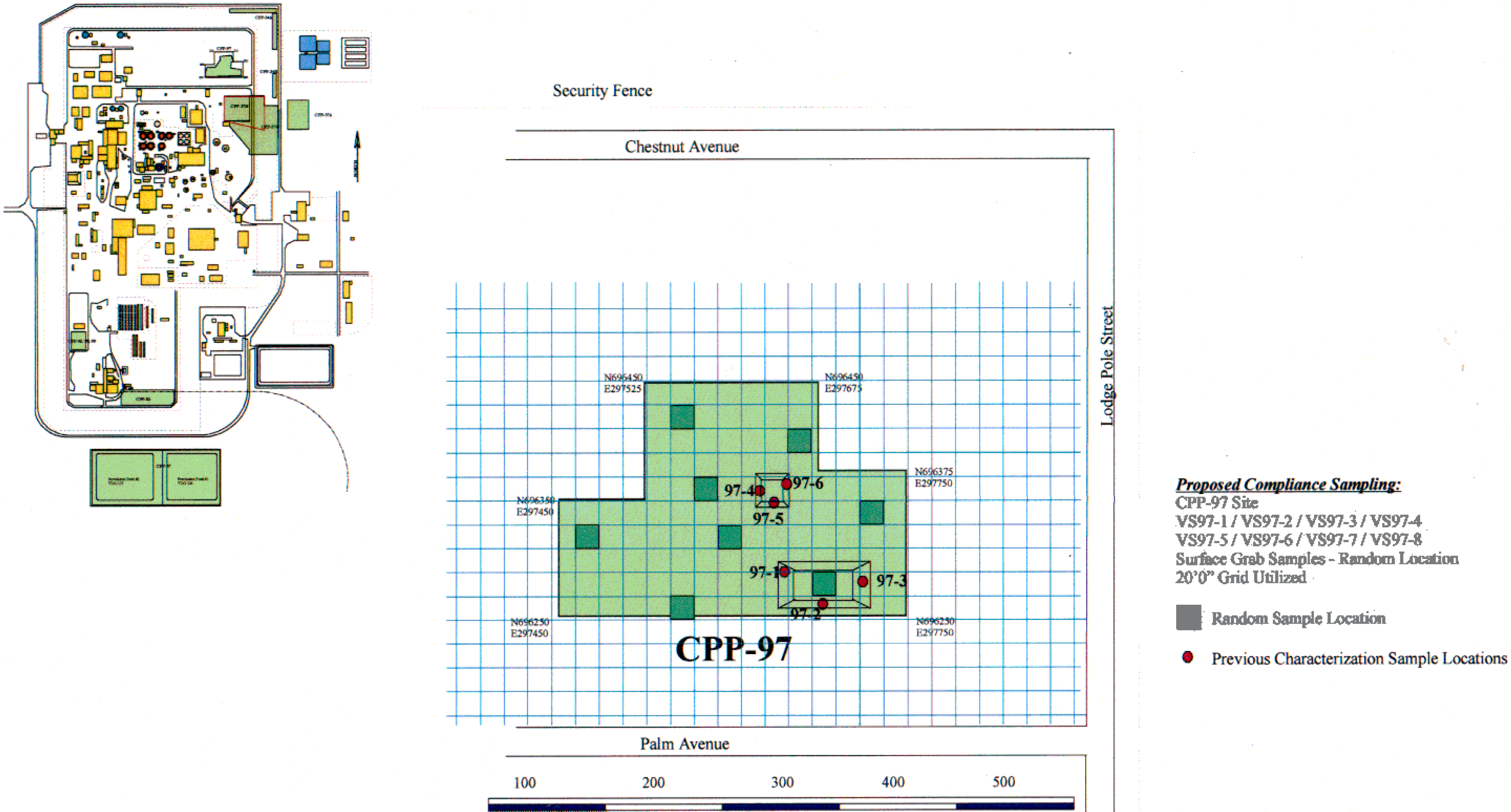
where

σ^2	=	estimated variance in measurements
n	=	number of samples required
Z	=	the p^{th} percentile of the standard normal distribution (from statistical tables)
Δ	=	AL - U (the minimum detectable difference)
U	=	parameter value where making a false negative decision error begins to be significant
AL	=	action level.

Data from *Background Dose Equivalent Rates and Surficial Soil Metal and Radionuclide Concentrations for the Idaho National Engineering Laboratory* (INEL 1996) were used to determine appropriate coefficients of variance (CVs) for background soils at the INEEL. The CV is used because it is assumed to be independent of the mean concentration, which is not the case in general for the variance. The CVs for our contaminants of concern are 46% for Cs-137, 38% for Sr-90, and 37% for mercury. The maximum CV of 46% was used to determine sample size. A gray area width equal to 30% of the AL was used because the maximum background concentrations are less than 5% of the RGs (INEL 1996). All background concentration sample results for the three contaminants of concern are less than 1 pCi/g or mg/g, while the RGs are 23 pCi/g, 223 pCi/g, and 23 mg/g for Cs-137, Sr-90, and mercury, respectively. Thus, post-remediation levels should be much less than 70% of the AL, and the decision criteria should be met without excessive sampling. Using a width of the gray area that is 30% of the AL results in U being defined as 70% of the AL. To calculate the sample size, the lower value of the gray area, U, is assumed to be true. Thus, the variance in Equation 3-1 is based on the CV as 46% of U. Because U is 70% of AL, the variance is estimated as (0.46)(0.7)AL = 32% AL. Assuming an acceptable chance of false positive decision error to be 5% when the true concentration is equal to the AL, and an acceptable chance of false negative decision error to be 20% when the true concentration is equal to U, the following equation shows the solution for n (number of samples required) using the project-specific variables. The values for 1-α and 1-β where obtained from EPA guidance (EPA 1989). The sample size is rounded up to the next largest integer (see Equation 3-2).

$$n = \frac{32^2\left(0.842 + 1.645\right)^2}{30^2} + (0.5)(1.645)^2 = 7.5 \uparrow 8 \tag{3-2}$$

A minimum of eight samples each will be collected from the bottom surface and sidewalls of the excavation areas at each of the soil remediation sites. Figures 3-2 through 3-5 present, for illustrative purposes only, examples of sampling grids and sample locations for the soil sites. If the FSP results are in the gray area, then further sampling may ensue. Further sampling to support a gray area decision within



REFERENCE FOR COMPLIANCE SAMPLING STRATEGY
US EPA Methods for Evaluating the Attainment of Cleanup Standards
Volume I: Soils and Solids Media, EPA 230/82-89-042, February 1989

From simple or Composite Random Sampling, Use Student's "T" Distribution
to compute number of samples to collect within a grid established for the soil site

Figure 3-2. Illustrative example of compliance sample locations for Site CPP-97.

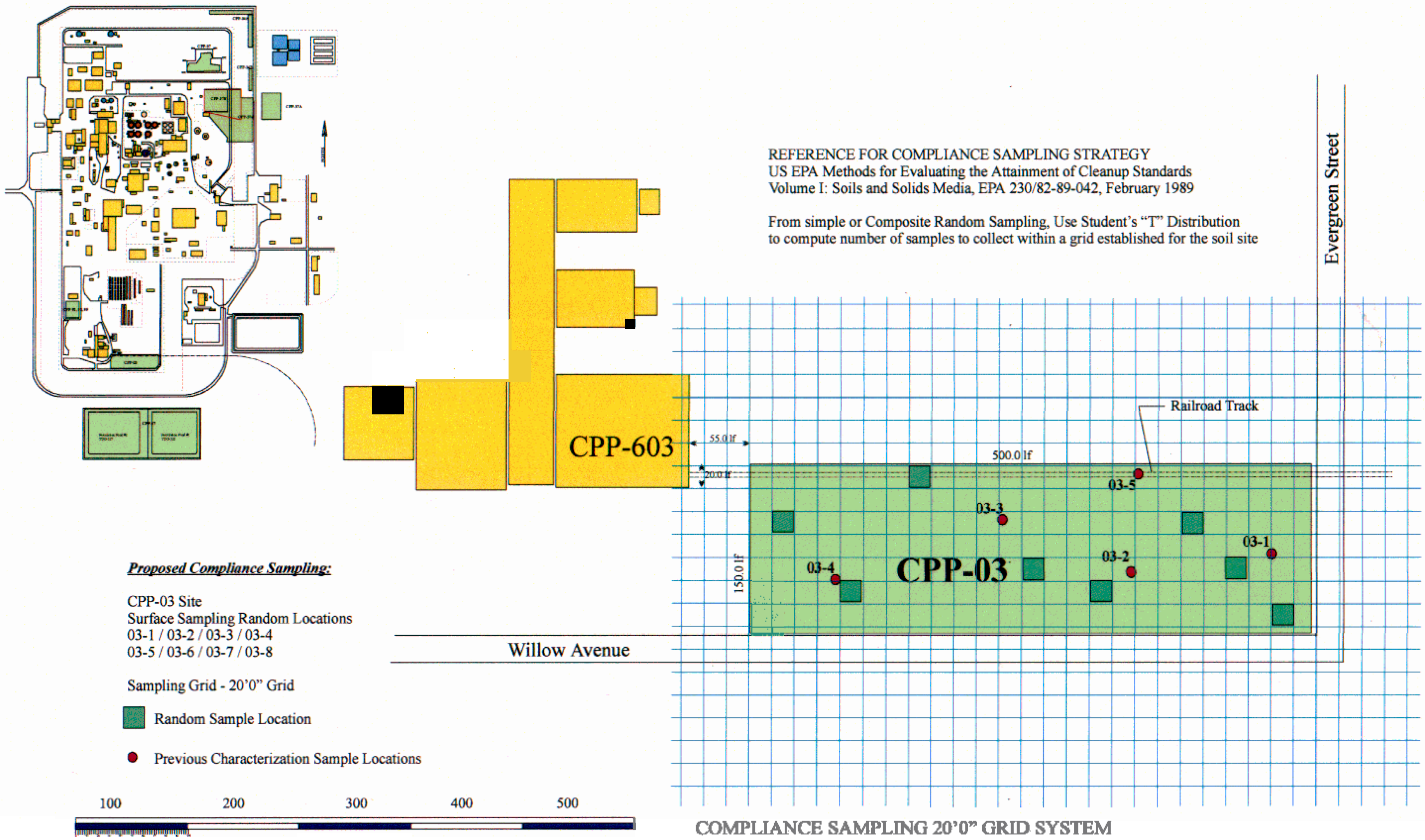


Figure 3-3. Illustrative example of compliance sample locations for Site CPP-03.

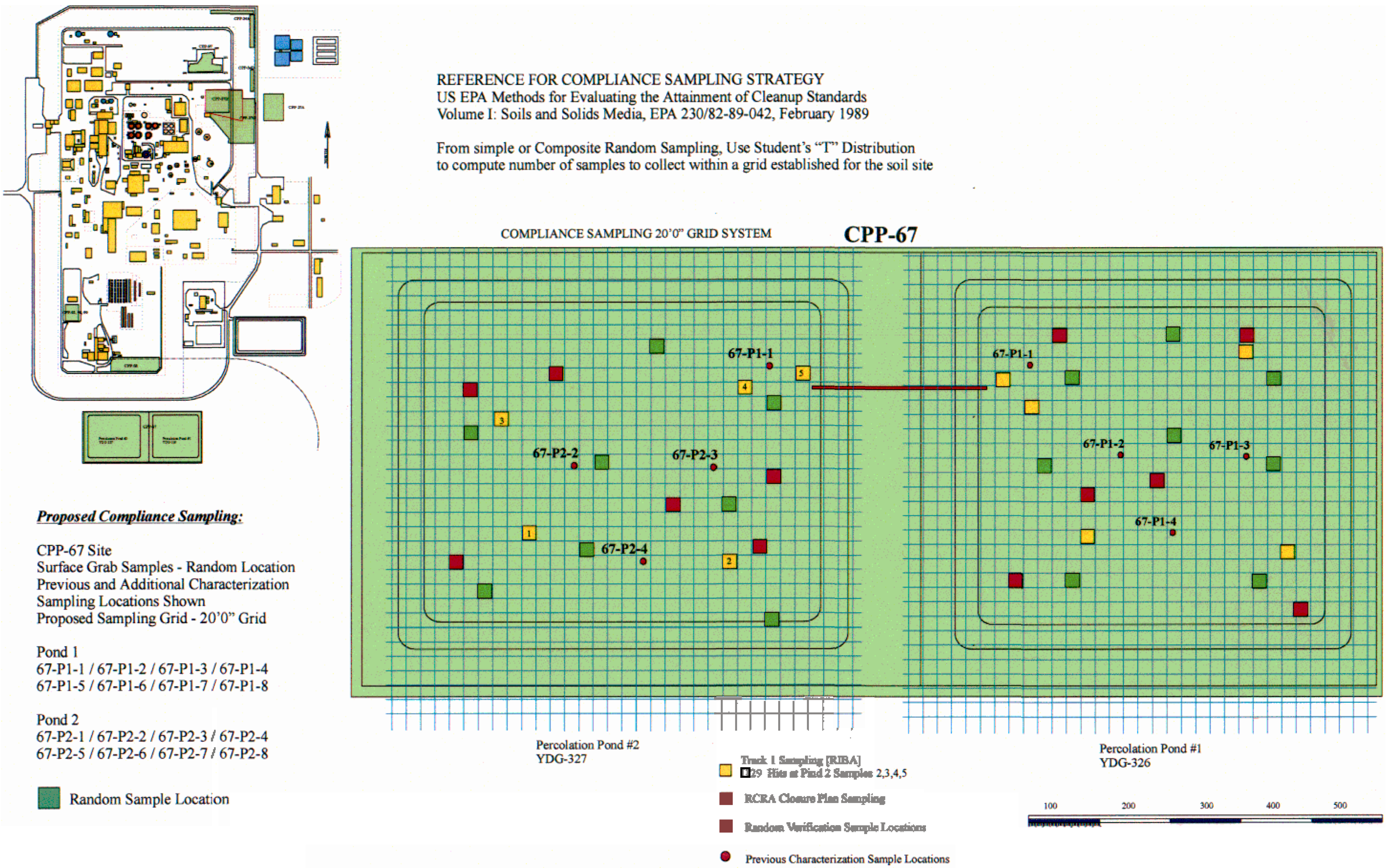


Figure 3-4. Illustrative example of compliance sample locations for Site CPP-67.

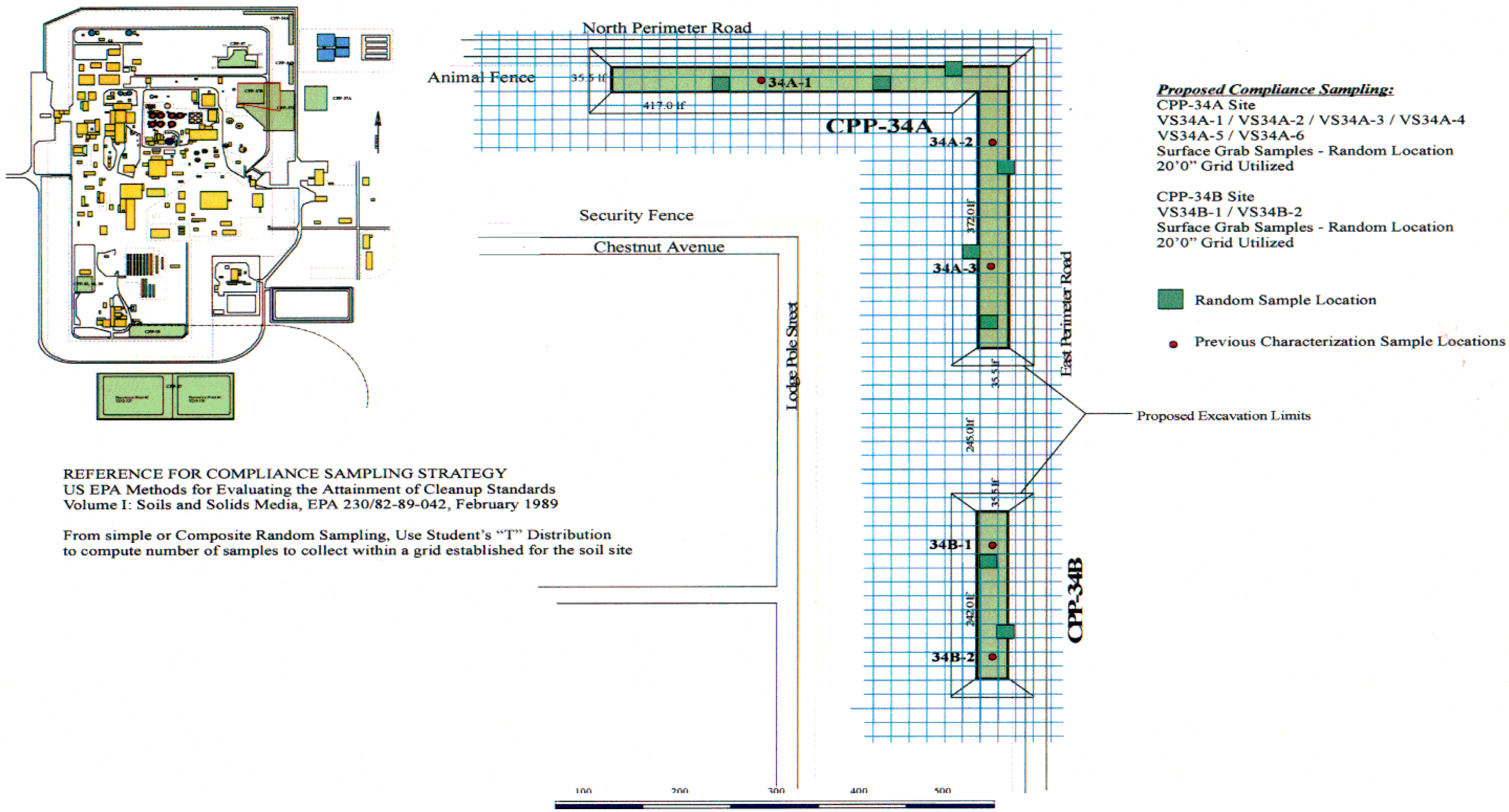


Figure 3-5. Illustrative example of compliance sample locations for Site CPP-34 A/B.

80% of the AL would amount to 12 additional samples being collected. If these additional samples do not refute the null hypothesis that the soil concentrations exceed the AL, then additional remediation will be performed. If these additional samples support the alternative hypothesis, then the site will be released.

3.2 Measurement Performance Criteria

The measurement quality objectives (MQOs) specify that measurements will meet or surpass the minimum requirements for data quality indicators established in the QAPjP (DOE-ID 2002). As a result, the technical and statistical quality of these measurements must be properly documented. Precision, accuracy, method detection limits (MDLs), and completeness must be specified for physical/chemical measurements. Additional analytical requirements are described qualitatively in terms of representativeness and comparability. These MQOs are described in the following sections. Table 3-2 presents the analytical performance requirements.

Table 3-2. Analytical performance requirements.

Analyte List	Survey/ Analytical Method	Preliminary Action Level	Practical Quantitation Limit	Precision Requirement	Accuracy Requirement
Gamma emitters (Cs-137, Eu-152, Eu-154)	Gamma spectroscopy	Cs-137 ≥23 pCi/g Eu-152 ≥270 pCi/g Eu-154 ≥5200 pCi/g	0.1 pCi/g	± 20%	80-120
Alpha emitters (Am-241, Pu-238, -239/240, Uranium, Np-237)	Alpha spectroscopy	Am-241 ≥290 pCi/g Pu-238 ≥670 pCi/g Pu-239/240 ≥250 pCi/g Uranium NA[a] Np-237 NA[a]	QAPjP (DOE-ID 2002)	± 30%	70-130
Beta emitters (Pu-241, Sr-90, H-3, I-129, Tc-99)	Liquid scintillation and/or gas flow proportional counting	Pu-241 ≥56,000 pCi/g Sr-90 ≥223 pCi/g H-3 NA[a] I-129 NA[a] Tc-99 NA [b]	QAPjP	± 30%	70-130
Mercury and chromium	SW-846 (EPA 1996)	Mercury ≥23 mg/kg Chromium ≥100 μg/L	QAPjP	± 30%	70-130

a. Preliminary action level is not applicable because the analyte is a COC for the SRPA.

b. Preliminary action level is not applicable because Tc-99 will be analyzed for future SRPA modeling purposes only.
COC = contaminant of concern
SRPA = Snake River Plain Aquifer
QAPjP = Quality Assurance Project Plan

Precision is a measure of agreement or reproducibility among individual measurements for the same property under the same conditions. Precision is expressed as relative percent difference, which is defined, and shown in Equation (3-3), as the absolute value of the difference divided by the mean, then expressed as a percentage.

$$RPD = \frac{(MS - MSD)}{(MS + MSD)/2} x100 \tag{3-3}$$

where

RPD	=	relative percent difference
MS	=	measured concentration of parameter in matrix spike sample
MSD	=	measured concentration of parameter in matrix spike duplicate sample.

The analytical laboratory will report the precision of their measurements of the matrix spike and matrix spike duplicate analyses conducted for inorganic analyses. For all radiochemical and some inorganic measurements, precision will be calculated using duplicate measurements of the same sample. Replicate measurements are used for metals determination after sample preparation, during instrumental analysis, and for mercury determinations postdigestion. Radiochemical measurements will use separate sample splits for solid samples to determine measurement precision.

Acceptable laboratory precision will be determined by method-specific criteria outlined in SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (EPA 1996), for total metals and each requested organic analysis. Acceptable radiochemical measurement precision will be determined using the guidance outlined in ER-SOW-394, "Idaho National Engineering and Environmental Laboratory Sample and Analysis Management Statement of Work for Analytical Services."

3.2.1 Accuracy

Accuracy is the relative agreement or nonagreement between a measured value and an accepted reference value. Accuracy reflects the measurement error associated with a measurement and is determined by assessing actual measurements in the sample matrix during the analysis of matrix spike samples. Accuracy is assessed by means of determining analyte recovery from matrix spikes, samples, or laboratory reference samples and is expressed as a percent recovery (%R). It is defined as the measured value divided by the true value expressed as a percent, as shown in Equation (3-4).

$$\%R \frac{C_{ss} - C_{us}}{C_{as}} x100 \tag{3-4}$$

where

$\%R$	=	percent recovery
C_{ss}	=	measured analyte concentration in spiked sample
C_{us}	=	measured analyte concentration in nonspiked samples (or zero for laboratory reference samples)
C_{as}	=	calculated or certified analyte concentration added to sample.

For inorganic analyses, the analytical laboratory will represent the accuracy of their measurements in the sample matrix as the results of the matrix spike data. Acceptable laboratory accuracy will be determined by assessing the results against method-specific criteria outlined in SW-846 (EPA 1996) for total metals and each requested organic analysis. Radiochemical method accuracy will be determined by assessing the results against the criteria outlined in ER-SOW-394. During the data quality assessment process, accuracy of the environmental measurements (in the form of bias, may be indicated by the measure discussed above) will be assessed to determine if there are any impacts on data use due to the accuracy of the data.

3.2.2 Detection Limits

The laboratory will use guidance found in SW-846 (EPA 1996) or 40 CFR 136, Appendix B, to aid in appropriately determining MDLs for organic and inorganic analytical methods and the requirements of ER-SOW-394 for setting minimum detectable activities (MDAs) for radiochemical measurements. The MDLs and MDAs are defined as the minimum concentration or activity of a substance that can be reliably measured and reported by a particular analytical method. Matrix effects, sample size, radiation levels, or other analytical interferences may increase MDLs or MDAs. The effects of these conditions on the laboratory's MDLs or MDAs, if determinable, will be documented.

Chemical methods for all total metals and other analyses typically use the standard deviation of replicate measurements of standards multiplied by a factor specified by the method or laboratory SOW to determine minimum MDLs. Estimated detection limits are provided in each of the appropriate analytical methods for chemical determinations and serve as a guide for purposes of this FSP. The laboratory will use standard radiochemistry and chemical analysis practices to ensure the MDLs approach those prescribed in the analytical laboratory SOW. Any significant deviations will be identified in the reported data.

Methods for the determination of radionuclides and applicable MDAs will be as defined in ER-SOW-394 or as defined in the project-specific analytical laboratory SOW. The laboratory will attempt to keep MDAs as low as possible, given the constraints of the sample matrix and any remote sample handling operations required to ensure the safety of laboratory personnel.

The laboratory analysts will follow the SW-846 (EPA 1996) and ER-SOW-394 methods as closely as possible to ensure the data are compliant with the requirements of the project. A smaller sample size may introduce a dilution effect, thereby elevating the detection level for a given sample or analysis. In the event that sample volume (or mass) prohibits the use of SW-846 (EPA 1996) protocols, the laboratory will make a good faith effort to assign methods that will provide acceptable, usable data and document all method deviations in the case narrative provided with the data package. Table 3-3 describes the analytical methods and detection limits for each contaminant of potential concern (COPC).

Table 3-3. Analytical methods and detection limits for each contaminant of potential concern.

Constituent	Analytical Method	Solids Detection Limits
Mercury and chromium	EPA Methods 3010A, 6010B, and 7470A	0.2-1000 mg/kg depending on metal
Strontium-90	Gas flow proportional (GFP)	0.5 pCi/g
Plutonium-241	Liquid scintillation counting (LSC)	1 pCi/g
Tritium	LSC	20 pCi/g
Iodine-129	GFP	1 pCi/g
Technetium	LSC or GFP	1 pCi/g

Table 3-3. (continued).

Constituent	Analytical Method	Solids Detection Limits
Plutonium isotopes	Alpha spectrometry (ALS)	0.05 pCi/g
Americium-241	ALS	0.05 pCi/g
Uranium-234, -235, and -238	ALS	0.05 pCi/g
Cesium-137	Gamma spectrometry (GMS)	a
Europium-152	GMS	a
Europium-154	GMS	a

a. Detection limit is indicated in the analytical method for each constituent.

3.2.3 Completeness

Completeness is the measure of the amount of valid analytical data obtained compared to the total number of data points planned. Valid analytical data are those generated when analytical systems and the resulting analytical data meet all data quality assessment (DQA) objectives outlined for the project (i.e., all calibration verification interference and other checks not affected by the sample matrix meet acceptance criteria). It is important to understand that data that are flagged during the data validation process are not necessarily invalid data. Part of the DQA process is the review of flagged data to determine whether the validation flags impact the intended use of the data. Therefore, the definition of "valid data" in the context of calculating completeness is "data that are acceptable for their intended purpose." Completeness of the reported data (expressed as a percentage) is calculated as shown in Equation (3-5).

$$C(\%) = M_v / Mt \times 100 \qquad (3\text{-}5)$$

where

$C(\%)$ = completeness

M_v = number of measurements determined to be valid per analyte

Mt = total number of measurements performed per analyte.

A completeness of 90% is a common goal. All data obtained from this project should meet the quality requirements and reporting protocols unless irregularities in the matrix (a.k.a. matrix effects) impede contaminant recovery, or a broken, spilled container results in a loss of sample materials. The completeness goal for the project is to obtain enough valid data to satisfy the DQO specifications.

3.2.4 Comparability

Comparability is the degree to which one data set can be compared to another obtained from the same population using similar techniques for data gathering. Comparability will be achieved through the use of consistent sampling procedures, experienced sampling personnel, the same analytical method for like parameters, standard field and laboratory documentation, and traceable laboratory standards.

3.2.5 Representativeness

Representativeness is a measure of the degree to which data accurately and precisely represent a characteristic of a population parameter at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative term that should be evaluated to determine whether in situ and other measurements are made and physical samples are collected in such a manner that the resulting data appropriately reflect population parameter of interest in the media and phenomenon measured or studied.

The sampling design discussed in Section 3.1.7 of this plan is the basis for obtaining data that are representative of the Group 3, Other Surface Soils, sites. The project manager (PM) and other project personnel will make a final determination of representativeness for the initial data set, following the return of the chemical and radiological analytical data.

3.3 Data Quality

In addition to primary project samples, QA/QC samples will be collected to establish the quantitative and qualitative criteria necessary to support the remedial action decision process and to describe the acceptability of the data by providing information both comparable to and representative of actual field conditions. To determine field accuracy, QA/QC samples consisting of field blanks and equipment rinsate blanks will be used. Quality control (duplicate) samples will be used to measure field and laboratory precision. The QA/QC sample results will be evaluated as outlined in the QAPjP (DOE-ID 2002). Table 3-4 provides an overview of QA/QC sample analysis for this sampling effort.

Table 3-4. Quality assurance/quality control samples.

QA/QC Sample Type	Comment
Duplicate	Field duplicates will be collected at a frequency of 1/20 samples, or 1/day/matrix, whichever is less.
Field blanks	Field blanks are only recommended for subsurface soils (>6 in.) collected for radionuclide analysis. Field blanks will be collected at a frequency of 1/20 samples, or 1/day, whichever is less.
Trip blanks	Trip blanks are not recommended for soil samples; thus, they will not be collected.
Equipment rinsate	Equipment rinsate samples will be collected at a frequency of 1/20 samples, or 1/day/matrix, whichever is less. Equipment blanks are not required if dedicated or disposable equipment is used.

3.4 Data Validation

Data will be acquired, processed, and controlled prior to input to the Integrated Environmental Data Management System (IEDMS), per INEEL internal procedures. For the samples submitted to the analytical laboratory, all data will be validated to Level B, in accordance with the QAPjP (DOE-ID 2002).

A data limitation and validation report, including copies of chain-of-custody forms, sample results, and validation flags, will be generated for each sample delivery group. All data limitation and validation reports associated with a site will be transmitted to the EPA and IDEQ within 120 days from the last day of sample collection. All definitive data will be uploaded to the IEDMS.

The Sample and Analysis Management (SAM) group will ensure the data are validated to Level B, as specified. The analytical method data validation will be conducted in accordance with current INEEL SAM data validation procedures. Validated data are entered into the IEDMS.

4. SAMPLING PROCESS DESIGN

Specific procedures are required to handle the samples collected during sampling activities to ensure that the data are representative of the soil. This section outlines the specific sampling process design for this activity. The sampling requirements discussed here will guide the collection of representative samples as specified in the DQOs (Section 3.1 of this plan). Procedures for sample collection are provided as guidelines for the field sampling team.

4.1 Presampling Meeting

Sampling procedures will be discussed each day in a presampling meeting. The meeting discussion will include, but is not limited to, sampling activities for the day, responsibilities of team members, health and safety issues, and waste management. Any deviations from the sampling strategy presented in this FSP will be documented in the field sampling logbook.

4.2 Sample Collection

Soil samples will be collected in accordance with INEEL sampling and analysis procedures. A grid will be established and sampling locations determined as specified in Section 3.1.7.1 of this plan.

Prior to being sampled, all sample locations will be located, staked, and clearly marked with the appropriate designations. Staked sampling locations will be surveyed to establish horizontal (northing and easting coordinates) and vertical (elevation referenced to mean sea level) control. Permanent benchmarks will be used to reference the vertical control data and the horizontal grid coordinates.

In addition to the systematic random sampling, samples may be collected wherever radiological screening identifies high areas of contamination above background levels. If ALs for health and safety concerns are sustained in the breathing zones, field personnel will be required to wear appropriate personal protective equipment (PPE) as determined by health and safety personnel.

An equipment rinsate will be collected from the sampling equipment that was used to collect the particular sample (e.g., hand auger, core barrel, stainless steel spoon) as required by the QAPjP (DOE-ID 2002). The field team members will use field guidance forms from INEEL SAM to ensure the proper jars and preservatives are used for each analysis type.

Table 6-1 of this FSP identifies the container volumes, types, holding times, and preservative requirements that apply to all soil and liquid samples being collected under this FSP. Following collection, the date and time of collection, as well as the sampler's initials, will be recorded on the sample label with a waterproof black marker and then covered with clear tape. The samples will be placed in coolers with blue ice (if required) while awaiting preparation and shipment to the appropriate laboratory. Samples will be prepared and packaged in accordance with INEEL chain-of-custody and sample labeling procedures.

4.3 Field Radiological Control Screening

Field screening using high-purity germanium (HPGe) detectors will be used during the sampling event for real-time characterization onsite to minimize sampling costs and provide faster results. Samples collected for RAO confirmation will be sent for laboratory analyses, but may also require field HPGe detectors.

Field screening using HPGe detectors for gamma radiation also will be performed prior to the initiation of sampling activities. Background radiation ranges will be obtained by measuring the naturally occurring radiation of uncontaminated soils in areas upwind of the sampling areas. The use of radiological screening instrumentation will be performed as determined by the health and safety officer, radiological engineer, and the radiological control technician (RCT). Radiological contaminants will be identified when surface screening indicates a reading greater than the values specified in INEEL radiological release surveys and control/movement of contaminated materials preestablished limits.

Using appropriate equipment, the project RCT will survey all samples obtained from this area for external contamination. The result will be documented on the sample label and the chain-of-custody form (discussed in Section 5). Requirements for release of materials from the Group 3, Other Surface Soils, sites will be documented in the project radiological work permit.

4.4 Personal Protective Equipment

The PPE required for this sampling effort is discussed in the project Health and Safety Plan (HASP) (INEEL 2004), and may include, but is not limited to, gloves, respirator cartridges, shoe covers, and coveralls.

4.5 Shipping Screening

Prior to releasing samples collected from radiologically contaminated areas of the site, the RCT will field screen all such samples to determine whether they meet the release criteria for unrestricted use. Samples that do not meet these criteria will be submitted to the Radiation Measurements Laboratory at the Test Reactor Area for a 20-minute gamma spectrometric analysis to determine the concentration of radionuclides present and the hazardous material classification for shipping purposes. Shipping screening could be onsite using HPGe, if it is acceptable to the hazardous materials shipper and current INEEL policy. All samples will be shipped to the laboratories by a company-certified hazardous materials shipper in accordance with U.S. Department of Transportation (DOT) regulations and current INEEL policy.

4.6 Field Decontamination

Field decontamination procedures are designed to prevent cross-contamination between locations and samples and prevent off-Site contaminant migration. All equipment associated with sampling (e.g., drilling equipment, spoons) will be thoroughly decontaminated prior to daily activities and between sample locations, in accordance with INEEL sample equipment decontamination procedures. Following decontamination, sampling equipment will be wrapped in foil to prevent contamination from windblown dust.

4.7 Sampling Waste Handling and Disposition

Waste streams generated as a result of sampling activities may include (but not be limited to) PPE, sample supplies and equipment, decontamination water (which may be used in small quantities during sampling), and excess or spent samples. All waste streams that are generated as a result of the sampling activities will be containerized, maintained, and disposed of in accordance with the project Waste Management Plan (DOE-ID 2004d).

5. SAMPLING DESIGNATION

Samples collected will be identified with a unique code and arranged in a SAP table and database. Specific SAP tables will be prepared prior to each sampling event. In an effort to minimize SAP discrepancies, SAP tables will be prepared immediately before each sampling event and the completed SAP tables will be included in the data summary report for each excavation site. The OU 3-13 project manager is responsible for SAP table accuracy.

5.1 Sample Identification Code

A systematic character identification (ID) code will be used to uniquely identify all samples. Uniqueness is required to maintain consistency and prevent the same ID code from being assigned to more than one sample.

The first designator of the code, 3, refers to the sample originating from WAG 3. The second and third designators, RA, refer to the sample being collected in support of the remedial action. The next three numbers designate the sequential sample number for the project. Regular and field duplicate samples will be designated with a two-character set (e.g., 01, 02). The last two characters refer to a particular analysis and bottle type.

For example, a soil sample collected in support of the remedial action might be designated as 3RA00101R4, where (from left to right):

- **3** designates the sample as originating from WAG 3.
- **RA** designates the sample as being collected for the remedial action.
- **001** designates the sequential sample number.
- **01** designates the type of sample (01 = regular, 02 = field duplicate).
- **R4** designates gamma spectrometric analysis.

The IEDMS database will be used to record all pertinent information associated with each sample identification code. Preparation of the plan database and completion of the SAM request for services are used to initiate the sample and sample waste tracking activities performed by the SAM.

5.2 Sampling and Analysis Plan Table/Database

5.2.1 General

A SAP table format was developed to simplify the presentation of the sampling scheme for project personnel. The following sections describe the information that will be recorded in the SAP tables.

5.2.2 Sample Description Fields

The sample description fields contain information relating to individual sample characteristics.

5.2.2.1 Sampling Activity. The sampling activity field contains the first six characters of the assigned sample number. The sample number in its entirety will be used to link information from other sources (field data, analytical data, etc.) to the information in the SAP tables for data reporting, sample tracking, and completeness reporting. The analytical laboratory will also use the sample number to track and report analytical results.

5.2.2.2 Sample Type. Data in this field will be selected from the following:

- REG for a regular sample
- QC for a QC sample.

5.2.2.3 Matrix. Data in this field will be selected from the following:

- Soil for soil samples
- Water for QA/QC samples.

5.2.2.4 Collection Type. Data in this field will be selected from the following:

- GRAB for grab
- COMP for composite
- FBLK for field blanks
- RNST for rinsates
- DUP for duplicate samples.

5.2.2.5 Planned Date. This date is related to the planned sample collection start date.

5.2.3 Sample Location Fields

This group of fields pinpoints the exact location for the sample in three-dimensional space, starting with the general AREA, narrowing the focus to an exact location geographically, and then specifying the DEPTH in the depth field.

5.2.3.1 Area. The AREA field identifies the general sample-collection area. The field should contain the standard identifier from the INEEL area being sampled. For this investigation, samples are being collected from INTEC.

5.2.3.2 Location. This LOCATION field may contain geographical coordinates, x-y coordinates, building numbers, or other location identifying details, as well as program-specific information, such as a borehole or well number. Data in this field will normally be subordinated to the AREA. Samples will be collected from the INTEC area. The LOCATION field identifier will correspond to this site.

5.2.3.3 Type of Location. The TYPE OF LOCATION field supplies descriptive information concerning the exact sample location. Information in this field may overlap that in the LOCATION field, but it is intended to add detail to the location (e.g., native soil).

5.2.3.4 Depth. The DEPTH of a sample location is the distance in feet from surface level or a range in feet from the surface.

5.2.4 Analysis Type

5.2.4.1 Analysis Type 1 through 20. The ANALYSIS TYPE (AT) fields indicate analytical types (radiological, chemical, hydrological, etc.). Space necessary to clearly identify each type is provided at the bottom of the form. A standard abbreviation should also be provided, if possible.

6. DOCUMENTATION MANAGEMENT AND SAMPLE CONTROL

The following discussions summarize document management and sample control requirements, as well as sample equipment and handling.

6.1 Documentation

The field team leader (FTL) will be responsible for controlling and maintaining all field documents and records and for ensuring that all required documents will be submitted to the Idaho Completion Project (ICP) Administrative Records and Document Control Office at the conclusion of the project.

Sample documentation, shipping, and custody procedures for this project are based on EPA-recommended procedures that emphasize careful documentation of sample collection and sample transfer. The appropriate information pertaining to each sample will be recorded in accordance with INEEL logbook practices and chain-of-custody procedures and the QAPjP (DOE-ID 2002). All personnel involved with handling, managing, or disposing of samples will be familiar with INEEL handling and shipping sample procedures, and all samples will be dispositioned accordingly.

A document action request (DAR) is required when field conditions dictate making any changes to this FSP, the project HASP, or other controlled project procedures (e.g., requiring additional analyses to meet appropriate Waste Acceptance Criteria). If necessary, a DAR will be executed in accordance with ICP document procedures.

All information recorded on project field documentation (e.g., logbooks, chain-of-custody forms) will be made in permanent ink. All field documentation errors will be corrected by drawing a single line through the error and entering the correct information; all corrections will be initialed and dated. In addition, photographs will be taken to document the field sampling activities.

6.1.1 Sample Container Labels

Waterproof, gummed labels generated from the IEDMS database will display information such as the sample ID number, the name of the project, sample location, depth, and requested analysis type. In the field, label information will be completed and placed on the containers before samples are collected. Information concerning sample date, time, preservative used, field measurements of hazards, and the sampler's initials will be recorded during field sampling.

6.1.2 Field Guidance Forms

Field guidance forms, provided for each sample location, will be generated from the IEDMS database to ensure unique sample numbers. Used to facilitate sample container documentation and organization of field activities, these forms contain information regarding the following:

- Media
- Sample identification numbers
- Sample location
- Aliquot identification
- Analysis type
- Container size and type

- Sample preservation methods
- Field logbooks.

In accordance with the Administrative Records and Document Control format, field logbooks will be used to record information necessary to interpret the analytical data. All field logbooks will be controlled and managed according to INEEL procedures. The FTL, or designee, will ensure by periodic inspection that the field logbooks are being maintained accordingly. The field logbooks will be submitted to the project files at the completion of field activities.

6.1.2.1 Sample Logbooks. Sample logbooks used by the field teams will contain such information as the following:

- Physical measurements (if applicable)
- Pertinent information for all QA/QC samples
- Shipping information (e.g., collection dates, shipping dates, cooler ID number, destination, chain-of-custody number, name of shipper).

6.1.2.2 Field Team Leader's Daily Logbook. A project logbook maintained by the FTL will contain a daily summary of the following:

- All team activities
- Problems encountered
- Visitors
- List of work site contacts
- Signature and date, which is entered by the FTL or designee at the end of each day's sampling activities.

6.2 Sample Equipment and Handling

Analytical samples for laboratory analyses will be collected in precleaned bottles and packaged according to American Society for Testing and Materials or EPA-recommended procedures. The QA/QC samples will be included to satisfy the QA/QC requirements for the field operation as outlined in the QAPjP (DOE-ID 2002). Qualified analytical and testing laboratories (approved by SAM) will analyze these samples.

6.2.1 Sample Equipment

Included below is a tentative list of necessary equipment and supplies. This list is as extensive as possible, but not exhaustive, and should only be used as a guide. Other equipment and supplies specified in the project-specific HASP are not included in this section. Sampling equipment that would come into contact with sample material will be cleaned prior to use, using an appropriate method (e.g., Alconox or similar nonphosphate soap with deionized water rinse, or equivalent). Field sampling and decontamination supplies may include the following:

- Stainless steel hand augers
- Drill rig capable of standard wire line coring
- Power auger
- Tape measure (30.5 m [100 ft])
- Wood stakes and ribbon (30.5 m [100 ft])
- Stainless steel spoons
- Stainless steel or aluminum composting pans
- Paper wipes
- Plastic garbage bags
- Deionized water (20 L [5.3 gal] minimum)
- Nonphosphate-based soap
- Isopropanol
- Spray bottles
- Aluminum foil
- Pipe wrench
- Crescent wrench
- Hammer
- Tables
- Certified ultrapure water (5 L [1.3 gal] JT Baker)
- Sample and shipping logbook
- FTL logbook
- Controlled copies of the FSP, QAPjP, HASP, and applicable referenced procedures
- Black ink pens
- Black ultrafine markers
- Sample containers, as specified in the QAPjP
- Preprinted sample labels and field guidance forms
- Nitrile or latex gloves
- Leather work gloves
- Ziploc™ plastic bags
- Custody seals.

Sample preparation and shipping supplies include the following:

- Pipettes
- pH paper

- Nitrile or latex gloves
- Paper wipes
- Parafilm™
- Clear tape
- Strapping tape
- Resealable plastic bags (such as Ziploc™) in various sizes
- Chain-of-custody forms
- Shipping request forms
- Names, addresses, telephone numbers, and contact names for analytical laboratories
- Task Order Statements of Work for analytical laboratories and associated purchase order numbers
- Vermiculite or bubble-wrap (packaging material)
- Plastic garbage bags
- Blue Ice™
- Coolers
- "This Side Up" and "Fragile" labels
- Address labels
- Sample bottles and lids
- Custody seals.

6.2.2 Sample Containers

Table 6-1 identifies container volumes, types, holding times, and preservative requirements that apply to all soil and liquid samples being collected under this FSP. All containers will be precleaned (typically certified by the manufacturer) using the appropriate EPA-recommended cleaning protocols for the bottle type and sample analyses. Extra containers will be available in case of breakage, contamination, or if the need for additional samples arises. Prior to use, preprinted labels with the name of the project, sample identification number, location, depth, and requested analysis will be affixed to the sample containers.

6.2.3 Sample Preservation

Water samples will be preserved in a manner consistent with the QAPjP (DOE-ID 2002). If cooling is required for preservation, the temperature will be checked periodically prior to shipment to certify adequate preservation for those samples that require temperatures of 4° C (39° F) for preservation. Ice chests (coolers) containing frozen reusable ice will be used to chill samples in the field after sample collection, if required.

6.2.4 Chain of Custody

The INEEL chain-of-custody procedures will be followed as well as the requirements in the QAPjP (DOE-ID 2002). Sample bottles will be stored in a secured area accessible only to the field team members.

Table 6-1. Sampling bottles, preservation types, and holding times.

Analysis	Volume and Type	Preservative	Holding Time
Mercury and chromium	Glass or plastic	4°C	180 days for all metals except mercury which is 28 days
Alpha radionuclides (Am-241, Pu-238, Pu-239/240, Uranium, Np-237)	High-density polyethylene (HDPE)	NA	180 days for all isotopes
Beta radionuclides (Pu-241, Sr-90, H-3, I-129, Tc-99)	HDPE	NA	180 days for all isotopes except I-129 which is 28 days
Gamma emitters (Cs-137, Eu-152, Eu-154)	HDPE	NA	180 days for all isotopes

NA = not applicable.

6.2.5 Transportation of Samples

Samples will be shipped in accordance with the regulations issued by DOT (49 CFR Parts 171 through 178) and EPA sample handling, packaging, and shipping methods (40 CFR 262.11). All samples will be packaged in accordance with INEEL chain-of-custody and sample labeling procedures.

6.2.5.1 Custody Seals. Custody seals will be placed on all shipping containers to ensure that tampering or unauthorized opening will not compromise sample integrity. The seal will be attached in such a way that opening the container requires the seal to be broken. Clear plastic tape will be placed over the seals to ensure that the seals are not damaged during shipment. Seals will be affixed to containers before the samples leave the custody of the sampling personnel.

6.2.5.2 On-Site and Off-Site Shipping. An on-Site shipment is any transfer of material within the perimeter of the INEEL. Site-specific requirements for transporting samples within Site boundaries and those required by the shipping/receiving department will be followed. Shipment within the INEEL boundaries will conform to DOT requirements as stated in 49 CFR 171 through 49 CFR 178. Off-Site sample shipments will be coordinated with INEEL Packaging and Transportation personnel, as necessary, and will conform to all applicable DOT requirements.

6.3 Documentation Revision Requests

Revisions to this document will follow INEEL ICP document procedures.

7. PROJECT ORGANIZATION AND RESPONSIBILITIES

The organizational structure is shown in Section 9 of the HASP (INEEL 2004).

8. REFERENCES

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